ON THE CONSTRUCTION OF BLENDING ELEMENTS FOR ENRICHED FINITE ELEMENTS

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Enriched finite element methods can be used to reproduce discontinuous boundary and interface conditions in element interiors. This paper discusses finite element schemes that are enriched by a partition of unity such as the extended finite element method (X-FEM) [1,2]. By doing so sharp material interfaces and boundaries can be represented by Eulerian (as well as Lagrangian) grids without requiring the grid conform to the boundaries and interfaces.

For computational efficiency, partition of unity enrichments are preferably localized to the sub-domains where they are needed. It is shown that an appropriate construction of the elements in the blending area, the region where the enriched elements blend to unenriched elements, is often crucial for good performance of local partition of unity enrichments. An enhanced strain formulation is developed which leads to good performance; the optimal rate of convergence is achieved. For polynomial enrichments, it is shown that a proper choice of the finite element shape functions and partition of unity shape functions also improves the accuracy and convergence. The methods are illustrated by several examples. The examples deal primarily with the signed distance function enrichment for treating discontinuous derivatives inside an element [3,4], but other enrichments are also considered. Results show that both methods provide optimal rates of convergence.

KEYWORDS: enriched finite element, X-FEM, level set, two-phase flow.

References

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